

ZOOLOGY.—A new cyclopoid copepod, *Hemicyclops visendus*, associated with *Upogebia* in Madagascar. ARTHUR G. HUMES, ROGER F. CRESSEY, and RICHARD U. GOODING,¹ Boston University.

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The specimens of the new clausidiid copepod described below were obtained by washing in 5 percent alcohol in filtered sea water more than 100 mud shrimps dug from their burrows in hard, intertidal mud at Nossi-Bé, Madagascar. We are indebted to Dr. Fenner A. Chace, Jr., for the identification of the shrimps as *Upogebia* (*Upogebia*) sp. (Crustacea, Anomura). Specimens of these have been deposited in the United States National Museum. We also wish to thank Dr. Jan H. Stock, who has allowed us to include certain unpublished material.

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All figures were drawn with the aid of a camera lucida. The letters after each figure refer to the scale at which the figure was drawn.

Hemicyclops Boeck, 1873

Hemicyclops visendus, n. sp.

Specimens studied.—37 females, 17 males, and several immature specimens washed from the body surface of *Upogebia* (*Upogebia*) sp. at Pointe à la Fièvre, Nossi-Bé, Madagascar, June 13, 1955. Holotype female, allotype, and 13 paratypes (10 females and 3 males) deposited in the Institut de Recherche Scientifique de Madagascar at Tananarive, the same number of paratypes in the United States National Museum, and the remaining paratypes in the authors' collection.

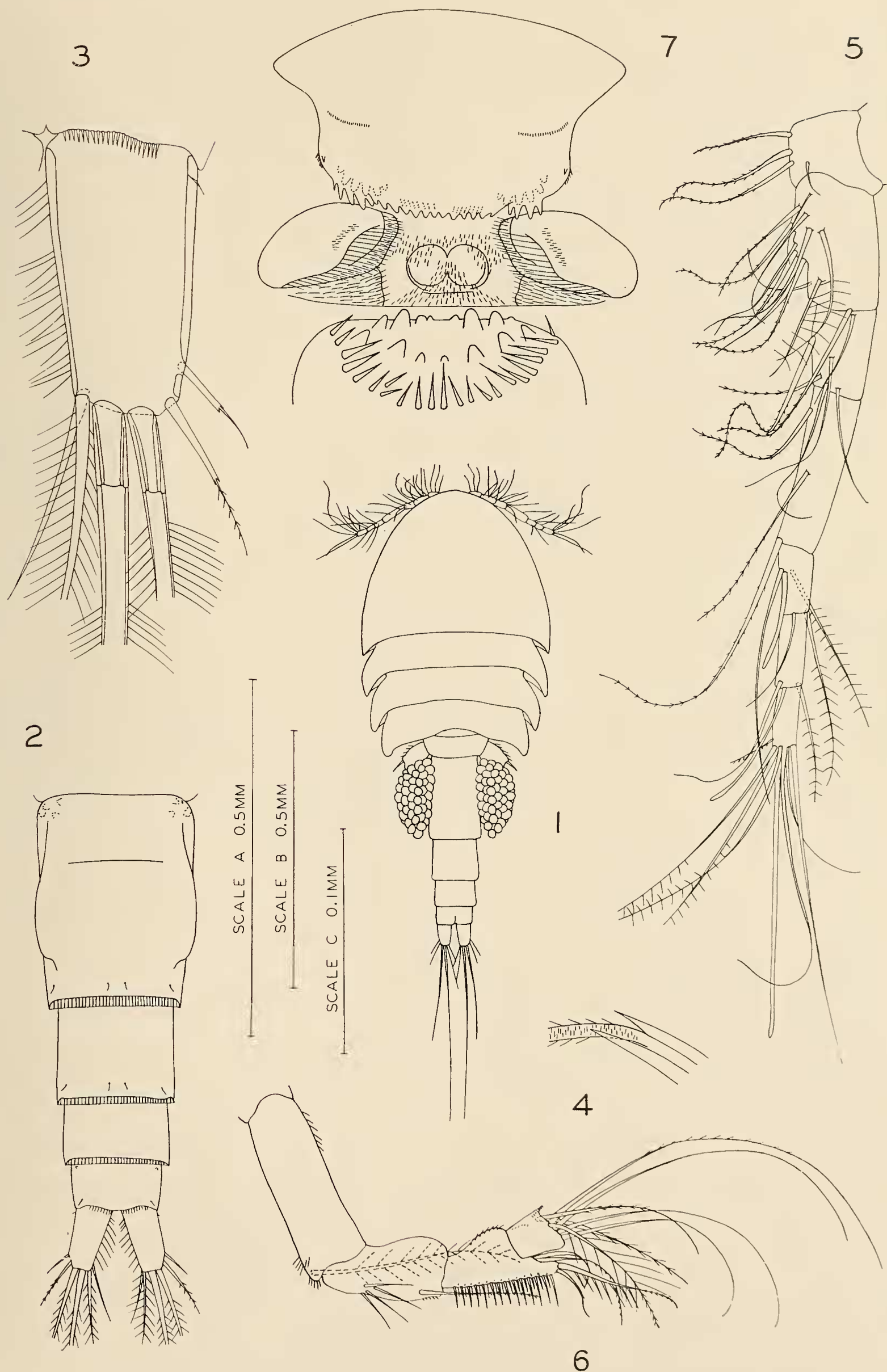
Female.—Body length 1.87 mm (1.82–1.96 mm), width 0.74 mm (0.74–0.77 mm), based on 10 specimens. Anterior part of the body, including the fifth pedigerous segment, about 1.3 times longer than the posterior part, including the genital segment, abdomen, and caudal rami (Fig. 1). Terga of the second, third,

and fourth pedigerous segments distinct with subacute posterolateral angles. First pedigerous segment fused with the head region, and the fifth narrow and not produced posterolaterally. Genital segment (Fig. 2) elongate, 360 x 266 μ , with a pair of long, low dorsolateral ridges and an indistinct transverse anterior furrow on its ventral surface, and having a striated, membranous posterior border. Egg sac attachments located on the extreme anterior corners. Abdomen (Fig. 2) 3-segmented, the segments 182, 120, and 90 μ in length, respectively, the first two with a striated, membranous posterior edge, the last with a posterior ventral row of spinules on either side of the midline. Caudal ramus (Fig. 3) about 1.7 times longer than wide, 120 x 70 μ , with the 6 setae, beginning with the innermost and slightly dorsal seta, 126, 210, 804, 492, 98, and 64 μ , respectively. Outermost two setae composed of a proximal half with the usual degree of sclerotization and a setuliform distal half, the junction between these as shown in Fig. 4. Inner margin of the ramus with a row of hairs. Outer margin with a minute hair near the base.

Egg sac (Fig. 1) somewhat variable in length, averaging about 270 x 125 μ , reaching to the posterior edge of the genital segment (or in some specimens almost to the beginning of the second abdominal segment) and containing many small eggs.

First antenna (Fig. 5) with 7 podomeres, their lengths being 57, 82, 61, 108, 44, 52, and 51 μ , respectively. An aesthetask on each of the last three podomeres. Certain setae with long, erect lateral hairs on the second, fifth, sixth, and seventh podomeres as shown in the figure. Very short lateral hairs on many of the remaining setae. Second antenna (Fig. 6) with 4 podomeres, the first elongate with groups of spinules and a long plumose seta on its inner distal angle; the second somewhat shorter with a group of slender spinules on its inner edge and a finely barbed seta on its inner distal angle; the third with a double row of long spinules on its inner edge and a row of small spinules along its slightly expanded outer edge,

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FIGS. 1-7.—*Hemicyclops visendus*, n. sp., female: 1, Dorsal view (A); 2, genital segment and abdomen, ventral (B); 3, caudal ramus, ventral (C); 4, detail of midregion of next to outermost seta of caudal ramus (D); 5, first antenna (E); 6, second antenna (E); 7, labrum, paragnaths, and labium bordering the oral region, ventral (C).

the inner distal angle of the podomere extended and bearing a small seta with a setuliform distal half, a prominent seta having its basal two-thirds armed with a row of 8 long spinules and its distal third filamentous and finely barbed, and 2 subterminal setae; the fourth podomere nearly quadrangular, offset on the third, bearing on its outer surface 2 comb-rows of spinules, and having 7 setae, 2 subterminal on the outer edge of the podomere and 5 terminal, 4 of these being linear, the fifth arising separately and having long lateral barbules.

Labrum (Fig. 7) with its posterior margin straight and composed of a median piece with 2 rows of teeth one above the other and a pair of lateral areas also with 2 rows of teeth. Other teeth and spinules as in the figure. Labium (Fig. 7) a broad area bearing 2 rows of teeth and an arcuate row of spines, all directed forward toward the mouth region. Between the labrum and the labium a bilobed area covered with very fine hairs. On each side just behind the paragnaths a triangular raised area also with fine hairs.

Mandible (Fig. 8) with a strongly sclerotized, elongate base bearing terminally a strongly sclerotized piece, a weaker spinulose blade having a row of toothlike spines on one side and a row of spinules on the other, and 2 barbed setae. Paragnath (Fig. 7) $78 \times 38 \mu$, situated close to the mandible and consisting of an oblong ridge covered with hairs, bearing the relation to the labrum and the labium as shown in the figure.

First maxilla (Fig. 9) with 2 distal lobes, one with 5 setae (4 of them with strong lateral spinules), the other lobe with a stout spine provided with 2 rows of spinules, and with 2 setae. A rounded projection on the inner side of the base of the appendage. Small spinules as shown in the figure.

Second maxilla (Fig. 10) composed of 2 podomeres, the first large and having at its inner distal angle 2 large, coarsely spinulose setae, one with its broadened base bearing an accessory seta. The second podomere smaller, not inflated, with its distal end forming a strong spine (without an articulation) bearing on its outer edge 2 strong accessory spines and distally a row of 3 or 4 smaller spines. Near the base of this large spine a seta with a broad, stalklike basal half and a slender, recurved distal half, the junction between the two halves showing 3 spinules. Subtermin-

ally on the podomere an outer seta with lateral hairs and a stout inner spine with an apparently bifid tip and having a double row of long spinules along the middle of its outer edge.

Maxilliped (Fig. 11) with 4 podomeres, the first two elongate and both bearing the usual 2 setae, the last 2 podomeres very short. Third podomere with a single outer seta. Last podomere with a strong recurved inner spine having 4 or 5 slender spinules along its concave edge, a shorter spine with an inner row of spinules on its inner edge, and with an accessory seta arising on its base, and 2 long setae and 3 spinules as shown in the figure.

Swimming legs with trimerous rami. Connecting piece between the first pair of legs with a row of long hairs, but in legs 2-4 a double row of spinules in this position. Armature of the rami of legs 1-4 as follows:

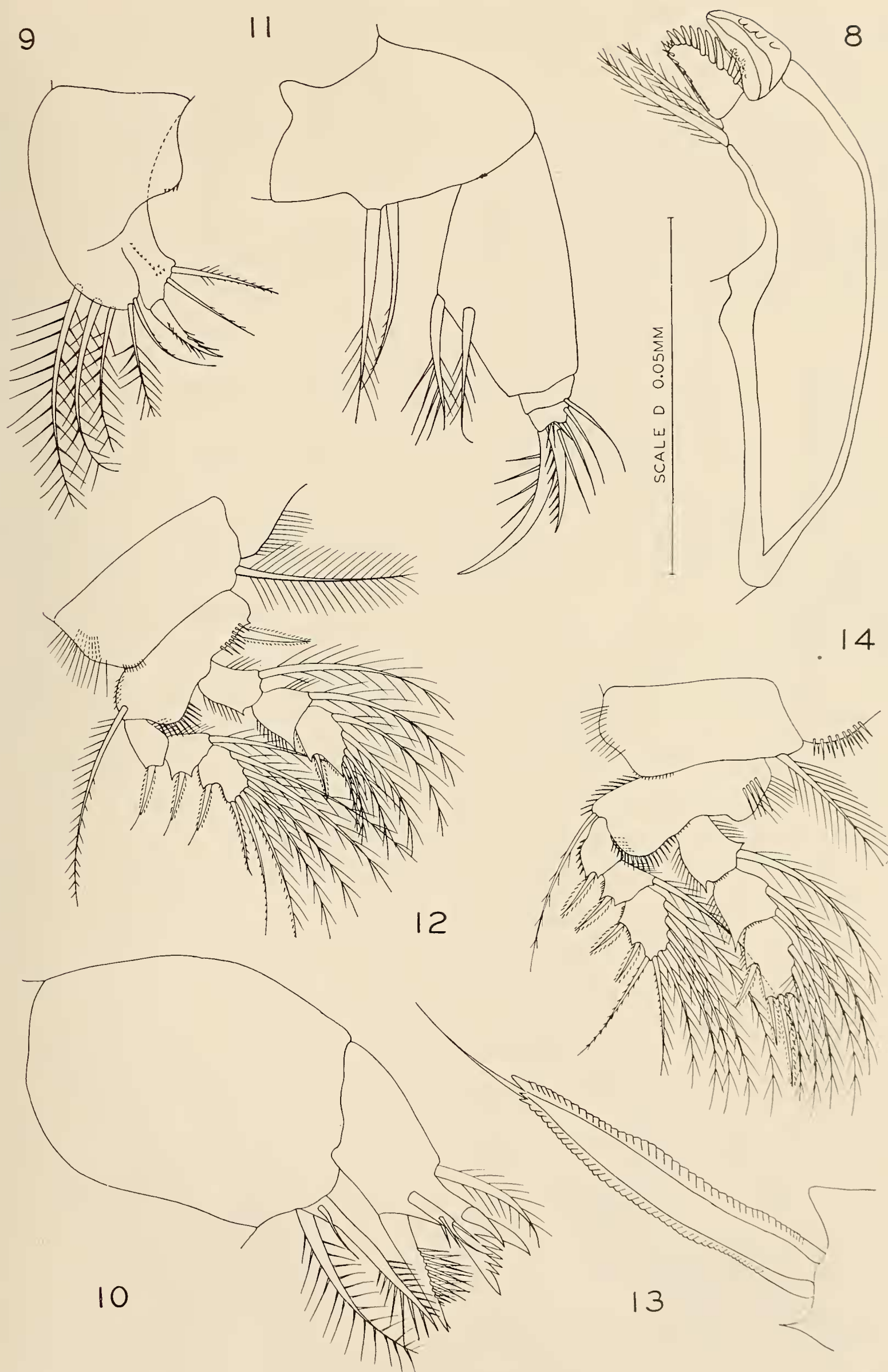
	<i>leg 1</i>		<i>leg 2</i>		<i>leg 3</i>		<i>leg 4</i>	
	exp	end	exp	end	exp	end	exp	end
1st podomere	1:0	0:1	1:0	0:1	1:0	0:1	1:0	0:1
2d podomere	1:1	0:1	1:1	0:2	1:1	0:2	1:1	0:2
3d podomere	8	6	9	6	9	6	8	5

Leg 1 (Fig. 12) with an inner spine on the basipodite. First three spines of the exopodite with a terminal setule (Fig. 13). Leg 2 (Fig. 14) with the basipodite extended laterad (a condition seen also in legs 3 and 4) and with a row of hairs on its inner margin instead of a spine. Leg 3 (Fig. 15) similar to leg 2. Leg 4 (Fig. 16) having the last podomere of the endopodite provided with three fringed spines, a seta half plumose and half fringed, and a plumose seta. The base of the next to outermost seta on the last exopodite podomere of legs 2-4 with 2-4 long inner hairs. Other ornamentation of the legs as shown in the figures.

Leg 5 (Fig. 17) with 2 podomeres, the first roughly quadrangular, about 100μ long, with 2 groups of long spinules and an outer seta 125μ long. Second podomere oval, $151 \times 98 \mu$, having the ratio of 1.54:1, with 2 fringed spines inserted on the outer edge of the distal half, 63 and 54μ long respectively, a naked seta 97μ long arising from a small terminal papilla, and an inner fringed spine 67μ long. Rows of spinules along the outer and inner edges of the podomere and near the bases of the outer spines as indicated in the figure.

Leg 6 absent.

Color in life under magnification in reflected light showing red speckling on the cephalothorax, eye red, egg sacs bright red.



FIGS. 8-14.—*Hemicyclops visendus*, n. sp., female: 8, Mandible (F); 9, first maxilla (C); 10, second maxilla (C); 11, maxilliped (E); 12, leg 1 (G); 13, outer spine of exopodite of leg 1 (D); 14, leg 2 (G).

Male.—Slightly larger than the female. Body length 2.06 mm (1.92–2.27 mm), width 0.77 mm (0.70–0.84 mm), based on 10 specimens. Anterior part of the body, including the fifth pedigerous segment, shorter in relation to the posterior part (Fig. 18). Genital segment (Fig. 19) wider than long, $252 \times 370 \mu$, with the sixth legs located on the posterior corners. Spermatophores (Fig. 20) oval, $112 \times 92 \mu$, with a short neck. Abdomen (Fig. 19) 4-segmented, the segments 215, 201, 154, and 100μ long respectively. Caudal ramus as in the female.

First antenna, second antenna, mandible, paragnath, and first maxilla like those of the female. Labrum (Fig. 21) with its posterior edge toothed as in the figure. Labium (Fig. 22) with a few blunt teeth on its anterior border and an irregular transverse row of spinules posteriorly. Region between the labrum and the labium similar to that in the female. Second maxilla (Fig. 23) with the stout inner spine on the second podomere of the female here replaced by a strongly sclerotized, broad hook lacking an articulation with the podomere. Outermost spine with its lateral spinules more conspicuous than in the female. Maxilliped (Fig. 24) with a single seta on the first podomere, the second podomere large with its inner side inflated and bearing rows of spinules and 2 setae, the third podomere very short and unarmed, and the last podomere consisting of a slender recurved claw 257μ long bearing near its inner base a slender setiform process (perhaps homologous to the innermost spine in the female maxilliped), a seta, and a very small spinule, as shown in the figure.

All swimming legs like those of the female, except for the absence of the inner basipodite spine on leg 1.

Leg 5 (Fig. 25) with the first podomere fused with the thoracic segment and bearing an outer seta 100μ long and a row of stout spinules. Second podomere elongate rather than oval as in the female, $243 \times 100 \mu$, the three spines and the seta being 67, 84, 98, and 81μ in length, respectively, from outer to inner. Outer edge of the podomere near the articulations of the outer two spines prolonged to form spinelike processes. Other armature as in the figure.

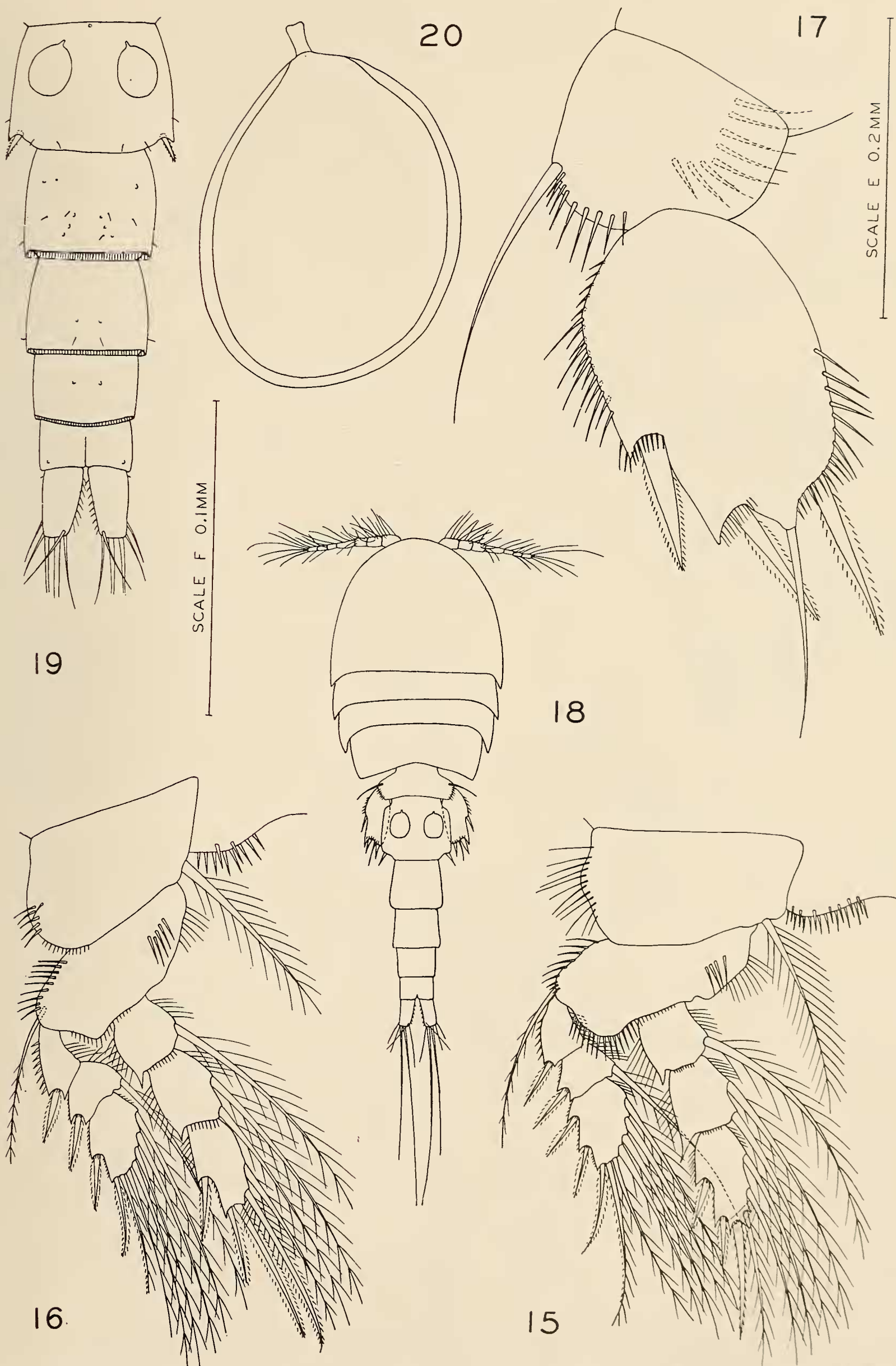
Leg 6 (Fig. 26) a strong spine 68μ long. Color similar to that of the female.

(The specific name is derived from *visendus*, worth seeing.)

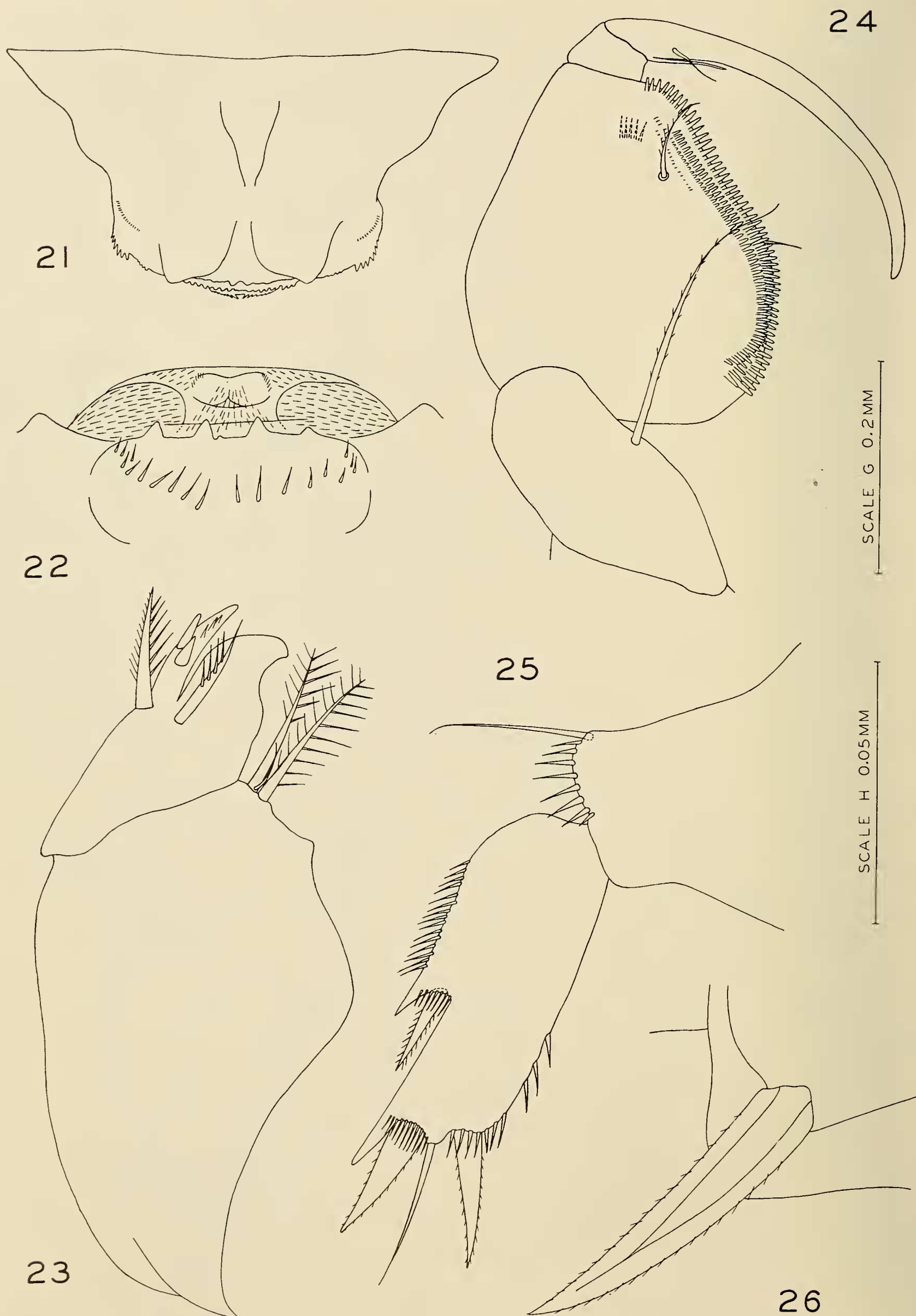
Remarks.—*Hemicyclops visendus* Humes, Cressey, and Gooding may be distinguished from other species in the genus chiefly by the form of the second podomere of the fifth legs, the length of the caudal rami, and the shape of the third and fourth podomeres of the second antenna. In *H. purpureus* Boeck, 1873, the inner distal angle of the third podomere of the second antenna is not produced and the form of the second podomere of the fifth leg of the female is less distinctly oval (as shown in the figures of Sars, 1917). In *H. adhaerens* (Williams, 1907) and in two new species to be described by Gooding (in press), one from the body surface and burrows of *Arenicola*, the other from washings and burrows of *Callianassa*, the last podomere of the second antenna is more than 2 times longer than wide and the second podomere of the fifth leg of the female is elongate (more than 2 times longer than wide). *H. elongatus* Wilson, 1937, has an elongate second podomere in the fifth leg of the female and the caudal ramus is at least 4 times longer than wide. In *H. thysanotus* Wilson, 1935, the second podomere of the fifth leg is much elongated and the caudal ramus is more than $3\frac{1}{2}$ times longer than wide.

Following the work of Gooding (in press), *H. callianassae* Wilson, 1935, and *H. pugettensis* Light and Hartman, 1937, are considered as synonyms of *H. thysanotus* Wilson, 1935, and *H. americanus* Wilson, 1932, is a synonym of *H. adhaerens* (Williams, 1907). Having examined specimens of *H. littoralis* (T. Scott, 1892), we support Sars's synonymy of this species with *H. purpureus* Boeck, 1873. These four species therefore need not be compared here. *Hersiliodes livingstoni* T. Scott, 1894, doubtfully attributed to *Hemicyclops* by Bocquet and Stock (1957) appears to us to belong to *Hersiliodes* rather than to Boeck's genus.

In *H. indicus* Sewell, 1949, *H. australis* Nicholls, 1944, *H. leggii* (Thompson and Scott, 1903), and *H. tamilensis* (Thompson and Scott, 1903) the caudal ramus is subquadrate, about as long as wide. Both *leggii* and *australis* have 2 setae (instead of one as in *visendus*) on the first podomere of the male maxilliped and *indicus* lacks the projection of the third podomere of the second antenna. In *H. aberdonensis* (T. Scott and A. Scott, 1892) the caudal



FIGS. 15-17.—*Hemicyclops visendus*, n. sp., female: 15, Leg 3 (G); 16, leg 4 (G); 17, leg 5 (C).
 FIGS. 18-20.—Same, male: 18, Dorsal view (A); 19, genital segment and abdomen, dorsal (B); 20, spermatophore (F).



FIGS. 21-26.—*Hemicyclops visendus*, n. sp., male: 21, Labrum, ventral (C); 22, labium and adjacent oral region (without paragnaths), ventral (C); 23, second maxilla (C); 24, maxilliped (E); 25, leg 5 (E); 26, leg 6, ventral (H).

ramus is about 3 times longer than wide, there are 2 setae on the first podomere of the male maxilliped, and the third and fourth podomeres of the second antenna are of about equal length and short. In *H. thompsoni* (Canu, 1888) the second podomere of the fifth leg of the female is somewhat elongate, the caudal ramus is about 2½ times longer than wide, and the second podomere of the second antenna bears a marginal row of spinules. *H. canuensis* Bourne, 1890, is, as suggested by Canu (1892, p. 254), probably a synonym of *thompsoni*, and need not be considered here.

In *H. bâcescui* (Serban, 1956) Stock, in press, the second podomere of the fifth leg of the female is 2.27 times longer than wide and the caudal ramus is about 2 times longer than wide. In *H. dilatatus* Shen and Bai, 1956, no oviducal openings or egg sacs were described on the single specimen known. There may, therefore, be some question whether the specimen is a mature female or a late copepodid. Assuming it to be mature, it differs from *visendus* in that the caudal ramus is shorter than the anal segment, the genital segment is subquadrate, the inner basipodite spine on leg 1 is long (about as long as the first 2 endopodite podomeres together), and the second podomere of leg 5 is elongate rather than oval.

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